

DOE OE Energy Storage Systems Safety Roadmap

GOAL

Foster confidence in the safety and reliability of energy storage systems.

BACKGROUND

Energy Storage Systems (ESS) are in increased demand for stationary applications. The aggressive adoption in the U.S. of stationary ESS has raised concerns about the degree of risks they pose, and questions about how to best understand and mitigate such risks. Stationary energy storage can bring with it risk management concerns and increase challenges associated with ensuring public safety. There is no expectation that the rapid evolution of stationary storage associated with energy storage technologies will slow as the costs continue to fall, new applications continue to be discovered, and policy initiatives continue to spur ESS implementation. There has been and continues to be a pressing need for coordinated, industry-wide action to improve the safety and reliability of energy storage systems.

In 2013, with the release of the Grid Energy Storage Strategy, the U.S. Department of Energy's, Office of Electricity Delivery and Energy Reliability (DOE OE) identified the challenges to widespread deployment of energy storage.¹ One of the central challenges identified was a concern about the risks associated with energy storage. This challenge provided the motivation for holding an energy storage safety workshop sponsored by DOE OE in 2014.² A wide range of stakeholders attended this workshop, and with their input, the DOE Energy Storage Safety Strategic Plan was developed and released in late 2014. DOE has fostered a number of efforts to address energy storage risk assessment and mitigation, including numerous publications, educational materials, communications and meetings organized under an ESS Safety working group. The working group was comprised of three sub-groups focusing on research and development (R&D), codes and standards, and education and outreach. Through their efforts, research has been facilitated, codes and standards have been updated, and information on risk identification and management has reached those having an impact on the deployment of energy storage systems. With a significant increase in R&D activities and in the number of

codes and standards that relate to ESS safety, Sandia National Laboratories held the ESS Safety Forum in early 2017. This brought together the energy storage community to share past efforts and research, as well as helped to identify the most critical needs going forward.

Understanding and mitigating safety risks associated with ESS are receiving greater attention. It has been identified that organizational work and collaborative efforts needed around safety can benefit if they are coordinated by an entity that does not represent any specific ESS development or implementation stakeholder. The DOE OE, through the national labs who support its activities in ESS safety, are shepherding these activities, facilitating efforts to identify and mitigate risks in ESS, and establishing the foundation needed to foster communication and collaboration amongst all ESS stakeholders.

INTRODUCTION

This document is the result of past efforts as described above and most notably the Energy Storage Safety Forum held in late February 2017 which had over 100 attendees representing a wide range of stakeholders associated with ESS development and adoption.

The primary focus of this roadmap is to establish a goal and then a path toward achieving that goal. The roadmap provides a specific goal and three distinct objectives identified to reach that goal. Each objective has specific tasks identified to enable successful realization of the objective. The tasks outlined under each objective fall naturally into the past activities associated with the ESS Working Group and are in line with other initiatives being undertaken by the wide range of stakeholders. The roadmap objectives fall into the following categories: research/development, codes/standards, and collaborative resources.

The areas of focus throughout the roadmap that are relevant to all three objectives include electrical safety, fire, and smoke hazard detection and mitigation, health and environmental hazards, natural and -man-made disasters, ventilation and thermal management, and system controls. These areas of focus are addressed beginning with system development

¹Grid Energy Storage, US DOE, December, 2013. http://www.sandia.gov/ess/docs/other/Grid_Energy_Storage_Dec_2013.pdf.

²Energy Storage Safety-Strategic Plan, US DOE, December, 2014. http://www.sandia.gov/ess/docs/other/DOE_OE_Safety_Strategic_Plan_Dec_2014_final.pdf.

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through to decommissioning or system refurbishment and include design, installation, commissioning, operation and maintenance, repair, decommissioning and reuse. Following the goals, objectives, and tasks, a section is provided focusing on the activities to implement the roadmap. The collaboration of all stakeholders will result in meeting the objectives and in turn realizing the goal together; ideally in a significantly more timely, robust and less costly manner than without the roadmap.

OBJECTIVES

The following objectives and associated tasks support the realization of the goal ‘to foster confidence in the safety and reliability of energy storage systems’.

1. Research and Development

Ensure that the most needed research is identified, prioritized, and communicated so the community can best minimize consequences from potential system failures. Facilitate collaboration through information and results sharing.

Engage with stakeholders, researchers, and other relevant parties to:

- a. Identify gaps such as testing that is needed, what should be measured and how, shortcomings of current information, and need for new test methods.
- b. Facilitate collaboration to design research and information gathering efforts to address the identified gaps.
- c. Identify available information, best practices, test results, etc. and facilitate the inclusion of relevant information into an ESS Collaborative Repository.

2. Codes and Standards

Apply research and development to support efforts that are focused on ensuring that codes and standards are available to enable the safe implementation of energy storage systems in a comprehensive, non-discriminatory and science-based manner.

- a. Review and assess codes and standards which affect the design, installation, and operation of ESS systems.
- b. Identify gaps in knowledge that require research and analysis that can serve as a basis for criteria in those codes and standards.
- c. Identify areas in codes and standards that are potentially in need of revision or enhancement and can benefit from activities conducted under research and development.
- d. Develop input for new or revisions to existing codes and standards through individual stakeholders, facilitated task forces, or through laboratory staff supporting these efforts.

3. Collaborative Resources

Create a conduit for effective communication using traditional and evolving media that will serve as a forum for involvement, information sharing and collaboration that allows stakeholders to be informed of activities being undertaken in support of energy storage safety and this roadmap.

- a. Develop and deploy an ESS collaborative repository strategy.
- b. Secure a commitment from stakeholder associations and organizations to participate in the development and deployment of the activities planned in the ESS collaborative repository strategy.
- c. Create a web-based information resource (Repository).
- d. Collect relevant information concerning energy storage system risks for inclusion in the Repository. Create resources to inform the community based on the results of objectives one and two. Organize the Repository for easy access and efficient navigation by all stakeholder groups.
- e. Foster the update and enhancement of the Repository information on an ongoing basis to facilitate communication regarding energy storage system risk assessment and mitigation.
- f. Monitor efforts associated with communication and collaboration, report on successes and identify and address areas where increased communication and collaboration are needed.

IMPLEMENTATION

Implementation of the roadmap envisions open, transparent, and ongoing communication and collaboration among all stakeholders and their associations and organizations.

The figure below depicts the unified implementation process involving organizing stakeholders and their respective associations and organizations to facilitate collaboration in risk management. The three areas that represent the above ESS safety objectives must be successfully conducted in concert in order to be realized and thereby to meet the goal.

For instance, outputs from R&D become the basis and supporting documentation for work under Codes and Standards. National laboratory staff are responsible for organizing and facilitating the work conducted in these areas, and for fostering the needed communication and collaboration. Individual stakeholders and/or their associations and organizations participate in one or more tasks, which in turn support an objective.

A coordinated, industry-wide effort guided by this roadmap, facilitated by the national labs, and supported by DOE OE, can achieve the goal above that all participants collectively share and support.